

Effect of sulfate and chloride anions on carbon steel interphase

Tunisian ground water is often characterized by a high concentration of ions such as calcium, magnesium, chloride, sulfateThe behavior of the carbon steel interface in contact with this water quality is equivalent to a surface coated by corrosion products layer including other salts (1). The precipitation of salts is favored by a local alcalinization at the metal surface due to dioxygen reduction. During the time, three layers cover the carbon steel/corrosion layer/natural water system : a green rust layer, brown oxyhydroxides layer and a black magnetite with good electronic conductivity (2). Mass transport of oxygen occurs towards these layers and control corrosion rate. Characterization of each layer was made basing on the equivalent circuit of figure 1.

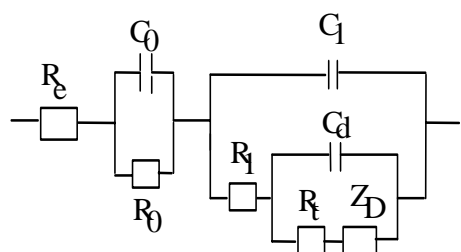


Figure 1 : Equivalent electrical circuit for a steel/corrosion products/water interphase.

R_e : electrolyte resistance, C_0 and C_1 : films capacitance, R_0 and R_1 : films resistance, C_d : double layer capacity, R_t : charge-transfer resistance, Z_D : diffusional impedance.

In this work, impedance spectroscopy was used to follow the effect of chloride and sulfate on the behavior of the carbon steel/corrosion layer/natural water system. Increasing the concentration of these ions has effects on :

- the electrolyte resistance and electron transfer on anodic and cathodic reactions (R_e , R_t , C_d)
- the physical, chemical and electronic characteristic of these layers (R_0 , C_0 , R_1 , C_1 , Diffusion coefficient and the thickness)

References:

- (1) : L. BOUSSELMI, C. FIAUD, B. TRIBOLLET, E. TRIKI (1997), The characterisation of the coated layer at the interface carbon steel - natural salt water by impedance spectroscopy, Corrosion Science, Vol 39, N°9, pp. 1711-1724.
- (2) : L. BOUSSELMI, C. FIAUD, B. TRIBOLLET, E. TRIKI (1999), Impedance spectroscopy study of a steel electrode in condition of scaling and corrosion, Interphase model, Electrochimica Acta 44, pp. 4357-4363.